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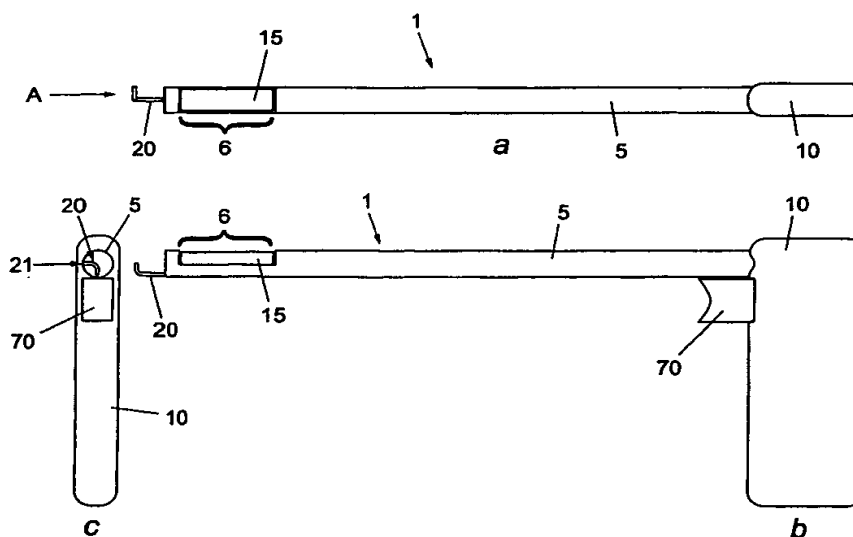
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/GB98/03263  <b>(22) International Filing Date:</b> 2 November 1998 (02.11.98)  <b>(30) Priority Data:</b> 9722939.7 31 October 1997 (31.10.97) GB  <b>(71) Applicant (for all designated States except US):</b> THE UNIVERSITY COURT OF THE UNIVERSITY OF DUNDEE [GB/GB]; Dundee DD1 4HN (GB).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> CUSCHIERI, Alfred [GB/GB]; Denbrae Mill, Strathkiness Low Road, St. Andrews, Fife K19 9TY (GB). FRANK, Graham, Timothy [GB/GB]; 37 Naughton Road, Wormit, Newport-on-Tay, Fife DD6 8NG (GB).  <b>(74) Agent:</b> MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QA (GB).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>Without international search report and to be republished upon receipt of that report.</i>

**(54) Title:** DEVICE FOR ENDOSCOPIC DELIVERY OF SURGICAL MATERIAL



**(57) Abstract**

A device for the delivery of a shape memory securing member into a confined space, the device having an exit for the securing member and means to move the securing member through the exit, the device further including a magazine having a plurality of channels each of which can store a securing member is described. Preferably, each securing member is restrained in the device in a first configuration, and upon passing through the exit adopts a second configuration. One form of the magazine is a barrel. The barrel may be rotatable around an axis, and the channels can be disposed parallel to said axis or may lie in a helical configuration. This arrangement can be likened to a "revolver barrel" on a firearm. One advantage of the present invention in surgery is that it can store several sutures or ligatures to allow multiple placements without the need to withdraw the instrument from the patient.

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1 DEVICE FOR ENDOSCOPIC DELIVERY OF SURGICAL MATERIAL

2

3 This invention relates to a delivery device.

4

5 Minimal access surgery (MAS) allows certain operations  
6 to be carried out through small access holes thus  
7 avoiding the creation of large traumatic wounds.

8 However difficulties arise in suturing surgical  
9 incisions and ligating inside the patient using current  
10 instruments due to the small size of the access hole  
11 which restricts movement of the instrument. Tying  
12 knots in suture and ligating threads is particularly  
13 difficult and time consuming.

14

15 In an attempt to overcome this problem, devices have  
16 evolved for manipulating needles within the body. One  
17 such device (disclosed in WO92/05828) comprises a  
18 cannula which may be inserted into the body through a  
19 narrow opening. The cannula houses a piston which is  
20 slidable within the cannula and manipulates a needle.  
21 The needle is retained inside the cannula during  
22 insertion of the cannula into the patient. The needle  
23 is formed from elastic material and when retained  
24 inside the cannula, the needle is held in a generally

1     straightened configuration. When the cannula is in  
2     place, the needle can then be projected from the end of  
3     the cannula to penetrate tissues and join wounds.  
4     Other items such as ring clips can be manipulated using  
5     the device. Several needles can be stored in the  
6     device in a straightened configuration. In such a  
7     configuration the needles exert a force on the device  
8     in an attempt to reform to their unstressed  
9     configuration. This causes difficulty in moving the  
10    needles within the device.

11

12    According to the present invention there is provided a  
13    device for the delivery of a shape memory securing  
14    member into a confined space, the device having an exit  
15    for the securing member and means to move the securing  
16    member through the exit, the device further including a  
17    magazine having a plurality of channels each of which  
18    can store a securing member.

19

20    Preferably, each securing member is restrained in the  
21    device in a first configuration, and upon passing  
22    through the exit adopts a second configuration.  
23    Also preferably, each channel is separately alignable  
24    with the exit.

25

26    One preferred form of magazine is a barrel. The barrel  
27    may be rotatable around an axis and the channels may be  
28    disposed parallel to said axis or may lie in a helical  
29    configuration. This arrangement can be likened to a  
30    "revolver barrel" on a firearm.

31

32    The first configuration in which the securing members  
33    are held inside the device is optionally straight.  
34    However, the securing members may be held in the device  
35    in a generally helical configuration. This partially

1     relaxes the securing members and allows the use of high  
2     curvature securing members which cannot easily adopt a  
3     straightened configuration. The high curvature  
4     securing members can form tighter coils when they pass  
5     through the exit of the device.

6  
7     Preferably, the second configuration is the form of a  
8     coil or loop. The coils may be overlapping (like a key  
9     ring) or may be partially open. The second  
10    configuration is preferentially adopted by the securing  
11    member in the absence of any other force. The loops of  
12    the second configuration may be round or some other  
13    shape such as a rounded oblong or a round cornered  
14    triangle. On leaving the device the securing member  
15    automatically adopts the second configuration, which is  
16    the preferred shape according to the shape memory of  
17    the member.

18  
19    The channels may include or be in the form of tubes  
20    which may themselves move within the device.  
21    The securing members may be housed within the tubes.  
22    The means to move the securing members may act upon the  
23    securing members direct or upon the tubes, to move a  
24    tube and a securing member housed therein towards the  
25    exit.

26  
27    When the securing members are stored within tubes, the  
28    tubes can be manipulated within the device more easily  
29    than the securing members alone. The tubes may be  
30    stored in parallel in the barrel, or may be stored  
31    sequentially in a line. The exit of the device may be  
32    so arranged as to contain the tubes but allow the  
33    securing members to pass from the tubes through the  
34    exit.

35

1 The magazine may have indexing means to align a  
2 securing member with the exit or with a second channel  
3 communicating with the exit. The indexing means may  
4 also align the securing member with the means for  
5 moving the securing member.

6

7 The magazine may also comprise other means of storing  
8 the securing members, such that the securing members  
9 are sequentially arranged in a column, line, row or  
10 helix, and are sequentially moved to the exit.

11

12 The magazine may be a replaceable element and may  
13 contain only sutures or ligatures or a selection of  
14 both, optionally in a defined order. The magazine(s)  
15 may be colour-coded for ease of use.

16

17 The means for moving the securing members may be  
18 disposed between the exit and the securing members,  
19 such that the securing members are pulled towards the  
20 exit, or alternatively, the securing members may be  
21 disposed between the exit and the means for moving the  
22 securing members, such that they are pushed towards the  
23 exit. In the first arrangement, the means for moving  
24 the securing members may comprise an inch worm motor or  
25 pinch wheel.

26

27 The exit of the device preferably comprises a tube  
28 which is curved in more than one plane. Optionally,  
29 the tube is curved once or twice to lie in two or three  
30 planes respectively and the exit is located at the end  
31 of the tube. The tube may be of circular cross-section  
32 or may be of a different cross-section, such as  
33 rectangular or oval.

34

35 The exit tube may be sharpened so that it can penetrate



1 tissue before the movement of the securing members  
2 through the exit. This may be desirable where the  
3 securing members do not easily penetrate the tissue  
4 surface. Where tissue penetration by an exit tube is  
5 undesirable, the exit tube may be replaced by a tube  
6 with a wide or bulbous end. The tube may be part of a  
7 detachable assembly that allows re-orientation or  
8 extension of the assembly. The assembly can be  
9 interchangeable with other forms of assembly to allow  
10 the use of eg left and right hand forms and straight  
11 forms.  
12

13 In an alternative form of the instrument, the exit may  
14 be embedded in in a more substantial member such as a  
15 half-round continuation of the main instrument body.  
16 One or more clamping jaws acting in opposition to the  
17 exit (or its more substantial containment structure)  
18 may be incorporated in order that it can easily be  
19 penetrated by the sutures. The device than has dual  
20 suturing and grasping functions. There may be two  
21 moving jaws, one behind the other, so that two  
22 connective folds of tissue may be grasped for suturing  
23 together. Each jaw would have a cutaway to allow  
24 passage of the suture. The jaw(s) may be activated  
25 from the handle by concentric connections on the  
26 instrument axis or in the form of external tubes.  
27

28 In another embodiment of the invention, an ultrasonic  
29 transducer may be incorporated in or near the exit.  
30 This may be used to excite vibrations in the suture in  
31 order to make it penetrate tissue more readily.  
32

33 In some embodiments, joints between (for example) exit  
34 tubes and other tubes in the device may be in the form  
35 of collars, where one tube end fits within an end of

1 another tube. This allows the securing members to be  
2 moved past joints between tubes more easily.  
3 Preferably, the inner faces of all tubes used are  
4 smooth.

5  
6 The securing members are preferably formed from shape  
7 memory alloy such as nickel-titanium (NiTi) alloy and  
8 may comprise elongate strips of said alloy which are  
9 coiled in the absence of any deforming force. The  
10 securing members could also be formed from stainless  
11 steel, from another biocompatible material (or coated  
12 material) or from material which is resorbable by the  
13 body.

14  
15 The securing members may be in the form of sutures  
16 which have at least one sharp end or may be in the form  
17 of ligatures having blunt ends. In the case of the  
18 ligature, the surgeon holds the exit of the device next  
19 to the body part to be ligated (eg, a blood vessel) and  
20 the ligature will wrap itself around the body part as  
21 it is expelled. Securing members in the form of  
22 sutures are formed with a sharp point at the leading  
23 end. The surgeon then places the device so that the  
24 point of the exiting sutures penetrates the tissue(s)  
25 to be sutured. The suture then re-coils upon exit and  
26 creates a join in the tissue(s). Also in the case of a  
27 suture, the exit tube may be required to deliver the  
28 suture in a plane normal to the axis of the instrument.

29  
30 A further advantage of the delivery device according to  
31 one embodiment of the present invention is that it can  
32 store several sutures or ligatures to allow multiple  
33 placements without the need to withdraw the instrument  
34 from the patient.

35

1 According to a second aspect of the present invention  
2 there is provided a device for the delivery of a shape  
3 memory securing member into a confined space, the  
4 device having an exit for the securing member, means to  
5 move the securing member through the exit, and means  
6 for cutting the securing member, preferably once a  
7 portion thereof has been passed through the exit.

8  
9 Preferably, upon leaving the device, the expelled  
10 portion of the securing member automatically adopts a  
11 configuration in accordance with its shape memory.

12  
13 The device according to the second aspect of the  
14 invention preferably contains a securing member in a  
15 continuous form, such as a roll, helix or coil. The  
16 configuration of the securing member preferably changes  
17 as it passes between the interior and exterior of the  
18 device. Thus when the securing member is in the form  
19 of a high-curvature coil of shape memory alloy, it can  
20 be maintained in a relaxed state (at or near its  
21 preferred shape according to its memory) when stored  
22 within the device, and need only be subjected to stress  
23 when its configuration changes upon leaving the device.

24  
25 The means for cutting the securing member is preferably  
26 disposed adjacent the exit so as to cut the securing  
27 member as it leaves the device. The means for cutting  
28 and the means for expelling may be provided by a single  
29 element, for example, a pinch wheel. The means for  
30 cutting may include means for sharpening the end of the  
31 securing member left inside the device.

32  
33 The present invention further provides a shape memory  
34 securing member for use in a device as defined above,  
35 the securing member having the form of a loop, coil or

1 a helix in the absence of any force acting upon it.

2

3 Embodiments of the present invention will now be  
4 described by way of example only and with reference to  
5 the accompanying drawings in which:

6

7 Fig. 1a shows a top view of a delivery device;

8 Fig. 1b shows a side view of the device of Fig.

9 1a;

10 Fig. 1c shows an end view on A of Fig. 1a.

11 Fig. 2a shows an end view of a barrel of the  
12 device of Fig. 1;

13 Fig. 2b shows a longitudinal sectional view along  
14 line B-B through the barrel of Fig. 2a;

15 Fig. 2c shows the opposite end view of the barrel  
16 of Fig. 2a;

17 Fig. 3 shows a detailed sectional view of the end  
18 of the device of Fig. 1 with the barrel of Fig. 2a  
19 in place;

20 Fig. 4a shows a side view of the device of Fig. 1  
21 with the barrel of Fig. 2a removed; and

22 Figs 4b and 4c show one end of second and third  
23 devices with an embedded exit and with a jaw for  
24 holding tissue against the exit.

25

26 Referring to Fig. 1a, b and c, a delivery device 1 has  
27 a housing 5 in the form of an elongate tube of an  
28 exemplary diameter of 10mm which has at one end a  
29 pistol grip 10 and at the other end a cut away section  
30 6. The cut-away section 6 is adapted to accept a  
31 magazine in the form of a barrel 15 which generally  
32 conforms to the outer shape of the housing 5 so as to  
33 fit into the cut-away section 6.

34

35 The housing 5 has a exit tube 20 attached to one end

1 thereof and communicating with the interior of the  
2 housing 5.

3

4 The exit tube 20 curves twice and has an exit 21 which  
5 faces one side of the device 1. The embodiment shown  
6 is one adapted for delivery of sutures and delivers the  
7 suture in a plane normal to the axis of the device.

8 The device of the invention may also be used for  
9 delivering ligatures and in such a case, the exit tube  
10 preferably curves once only and the second curve shown  
11 in the exit tube 20 is not required.

12

13 Referring now to Fig. 2a, b and c, the barrel 15  
14 comprises an inner hollow cylinder 15a and an outer  
15 hollow cylinder 15b. The outer cylinder 15b has twelve  
16 grooves 25 on the inner surface thereof which extend  
17 along the length of the cylinder 15b. The grooves 25  
18 are preferably formed by wire erosion and in the  
19 example shown have a diameter of 0.3mm. The two  
20 cylinders 15a and 15b can be fitted together as shown  
21 in the drawings such that the grooves 25 form channels  
22 from one end of the barrel 15 to the other. Securing  
23 members are disposed in the grooves 25 in use of the  
24 device. The securing members are typically formed from  
25 shape memory alloy wire such as NiTi wire and in the  
26 present example, are 0.25mm in diameter. The inner  
27 cylinder 15a has an axial bore 28 extending  
28 therethrough and in one end face 12 has indentations 30  
29 which extend a short distance into the cylinder 15a in  
30 an axial direction. In the opposite end face of the  
31 inner cylinder 15a is a slot 32 which intersects with  
32 the end of the bore 28.

33

34 Referring now to Fig. 3, the end of the device 1 which  
35 holds the barrel 15 has an end stop 35 located after

1 the cut-away section 6. The end stop has an axial  
2 indentation or bore 29 on the internal face extending  
3 at least partially along the axis of the end stop 35  
4 and which is co-axial with bore 28 when the barrel 15  
5 is in place in the cut-away section 6. The end stop 35  
6 also has an annular arrangement of twelve bores 38 in  
7 its inner face in which are located springs 40 and ball  
8 bearings 42. The springs 40 bear on portions 35a of  
9 the outer wall of end stop 35 and exert force on the  
10 ball bearing 42 so as to expel them from the bores 38  
11 in the direction of the pistol grip 10. Typically, the  
12 ball bearings 42 are restrained from leaving the bores  
13 38 entirely and may be held captive on the springs 38  
14 or embedded in the end stop 35.

15

16 When the barrel 15 is in place in the cut-away section  
17 6, the ball bearings 42 are forced out of the bores 38  
18 and engage with the indentations 30 in the barrel 15.  
19 Thus a series of twelve detent positions is  
20 established.

21

22 An axle 50 (shown in Fig. 4a) is withdrawn from the  
23 cut-away section 6 by a handle 51. The barrel 15 (not  
24 shown in Fig 4a) is loaded with twelve securing members  
25 such as sutures formed from NiTi shape memory alloy,  
26 and is located in the cut-away section 6. The sutures  
27 are held in a generally straightened configuration in  
28 the grooves 25 of the barrel 15. The axle 50 is then  
29 moved towards the end stop 35 by manipulating the  
30 handle 51 such that the axle 50 passes through the bore  
31 28 and engages in the axial bore 29 in the end stop 35.  
32 Additionally a pair of projections 52 on the axle 50  
33 are disposed in the slot 32 on the barrel 15 thereby  
34 locking the barrel 15 against axial rotation with  
35 respect to the axle 50. The barrel 15 is thereby

1 locked in place in the cut-away section 6 and can be  
2 rotated through its detent positions by manipulation of  
3 the axle 50. The detent positions are held by the  
4 action of the ball bearings 42 engaging in the  
5 indentations 30.

6  
7 The barrel 15 is released by sliding back the handle 51  
8 so as to disengage the projections 52 from the slots 32  
9 and the axle 50 from the bore 28. The barrel 15 can  
10 then be removed and reloaded or replaced with one  
11 already loaded.

12  
13 In each of the detent positions a respective one of the  
14 grooves 25 is in line with the exit tube 20, thus  
15 allowing a securing member (not shown) such as a suture  
16 or ligature to be expelled from the groove 25 through  
17 the exit tube 20 and out of the exit 21.

18  
19 The housing 5 also includes a flexible push wire 55  
20 which is supported in a guide tube 58. The end of the  
21 guide tube 58 is in line with the exit tube 20 and with  
22 a respective one of the grooves 25 when the barrel 15  
23 is in a detent position.

24  
25 The push wire 55 is slidable in the guide tube and can  
26 be moved so as to protrude into a respective one of the  
27 grooves 25 when the barrel 15 is in a detent position  
28 in the cut-away section 6. The push wire 55 is clamped  
29 by a sliding clamp 60 which is moved by a rack and  
30 pinion mechanism 65 located in the pistol grip 10. The  
31 rack and pinion mechanism 65 is in turn activated by a  
32 trigger 70.

33  
34 The rack and pinion mechanism 65 has gears which  
35 increase the movement of the trigger 70 and reverse its

1 direction so as to advance the clamp 60 towards the  
2 barrel 15 located in the cut-away section 6.

3  
4 Movement of the push wire 55 along the support tube 58  
5 and into the groove 25 expels a securing member located  
6 therein from the exit tube 20. Thus actuation of the  
7 trigger 70 causes the push wire 55 to push a securing  
8 member from one of the grooves 25 out of the exit tube  
9 20. Upon leaving the exit tube 20, the securing member  
10 no longer has any force acting upon it to maintain it  
11 in its straightened configuration, and it re-coils into  
12 its preferred shape memory configuration of a loop or  
13 coil.

14  
15 The movement of the trigger 70 could also cause the  
16 barrel 5 to rotate through one detent position so that  
17 the next groove 25 is aligned with the exit tube 20 and  
18 the support tube 58. The barrel-rotation mechanism  
19 (not shown) is similar to the mechanisms found in some  
20 ball-point pens.

21  
22 Different barrels may hold different securing members  
23 for different purposes, or a single barrel may hold a  
24 number of different securing members.

25  
26 Figure 4b shows the end of a second device according to  
27 the present invention, having its exit 72 embedded in a  
28 semi-circular extension 74 of the main body of the  
29 device 76. Adjacent the exit 72 is a moveable clamping  
30 jaw 78, in which is a cutaway 80 through which an  
31 exiting securing member can pass. Tissue can be  
32 grasped between the exit 72 and the jaw 78. Figure 4c  
33 shows a third device having two moveable jaws 82  
34 opposite the device exit 84.

35



- 1 Modifications and improvements may be incorporated
- 2 without departing from the scope of the invention.
- 3

## 1 CLAIMS

- 2
- 3
- 4 1. A device for the delivery of a shape memory
- 5 securing member into a confined space, the device
- 6 having an exit for the securing member and means
- 7 to move the securing member through the exit, the
- 8 device further including a magazine having a
- 9 plurality of channels each of which can store a
- 10 securing member.
- 11
- 12 2. A device as claimed in Claim 1 wherein each
- 13 channel of the magazine is separately alignable
- 14 with the exit.
- 15
- 16 3. A device as claimed in Claim 1 or Claim 2 wherein
- 17 the or each securing member is restrained in the
- 18 device in a first configuration, and upon passing
- 19 through the exit adopts a second configuration.
- 20
- 21 4. A device as claimed in any one of Claims 1 to 3
- 22 wherein the or each securing member is made from
- 23 nickel-titanium alloy or stainless steel.
- 24
- 25 5. A device as claimed in any one of the preceding
- 26 Claims wherein the magazine is a barrel.
- 27
- 28 6. A device as claimed in Claim 5 wherein the barrel
- 29 is rotatable about an axis.
- 30
- 31 7. A device as claimed in Claim 6 wherein the
- 32 channels are arranged along the barrel and
- 33 disposed parallel with the axis.
- 34
- 35 8. A device as claimed in Claim 6 wherein the
- 36 channels are arranged along the barrel and

1 disposed in a helical configuration to the axis.

2

3 9. A device as claimed in any one of Claims 3 to 8  
4 wherein the second configuration is the form of a  
5 coil or loop.

6

7 10. A device as claimed in any one of Claims 3 to 9  
8 wherein the second configuration of the securing  
9 member is the preferred shape according to the  
10 shape memory of the securing member.

11

12 11. A device as claimed in any one of the preceding  
13 Claims wherein the magazine is lockable within the  
14 device.

15

16 12. A device as claimed in any one of the preceding  
17 Claims wherein the magazine is loaded with a  
18 plurality of securing members.

19

20 13. A device as claimed in any one of the preceding  
21 Claims wherein the channels include or be in the  
22 form of tubes.

23

24 14. A device as claimed in any one of the preceding  
25 Claims wherein the magazine has indexing means to  
26 align a securing member with the exit or with a  
27 second channel communicating with the exit.

28

29 15. A device as claimed in Claim 14 wherein the  
30 indexing means aligns the securing member with the  
31 means for moving the securing member.

32

33 16. A device as claimed in any one of the preceding  
34 Claims wherein the magazine is removable from the  
35 device.

36

- 1       17. A device as claimed in any one of the preceding  
2       Claims wherein the means for moving a securing  
3       member is disposed between the exit and the or  
4       each securing member.  
5
- 6       18. A device as claimed in any one of Claims 1 to 16  
7       wherein the or each securing member is disposed  
8       between the exit and the means for moving the  
9       securing member.  
10
- 11      19. A device as claimed in Claim 18 wherein the means  
12      for moving the securing member is a push wire.  
13
- 14      20. A device as claimed in Claim 19 wherein the push  
15      wire is flexible and slidable in a guide tube.  
16
- 17      21. A device as claimed in any one of the preceding  
18      Claims in which the exit comprises a tube.  
19
- 20      22. A device as claimed in Claim 21 wherein the free  
21      end of the tube is sharpened.  
22
- 23      23. A device as claimed in Claim 21 or Claim 22  
24      wherein the tube is curved.  
25
- 26      24. A device as claimed in any one of Claims 21 to 23  
27      wherein the tube is detachable.  
28
- 29      25. A device as claimed in any one of the preceding  
30      Claims wherein the device includes one or more  
31      clamping jaws acting in opposition to the exit.  
32
- 33      26. A device as claimed in Claim 25 wherein one or  
34      more of the jaws is moveable, and wherein a  
35      securing member is passable through one or more of  
36      the jaws.

- 1      27. A device as claimed in any one of the preceding  
2           Claims wherein the device includes an ultrasonic  
3           transducer located in or near the exit.  
4
- 5      28. A device for the delivery of a shape memory  
6           securing member into a confined space, the device  
7           having an exit for the securing member, means to  
8           move the securing member through the exit, and  
9           means for cutting the securing member or a portion  
10          of the securing member that has passed through the  
11          exit.  
12
- 13     29. A device as claimed in Claim 28 wherein the  
14           expelled portion of the securing member  
15           automatically adopts a configuration in accordance  
16           with its shape memory.  
17
- 18     30. A device as claimed in Claim 29 wherein the  
19           adopted configuration is a coil or loop.  
20
- 21     31. A device as claimed in Claim 28, 29 or Claim 30  
22           wherein the securing member in the device is in a  
23           continuous form.  
24
- 25     32. A device as claimed in Claim 31 wherein the  
26           configuration of the securing member changes as it  
27           passes between the interior and exterior of the  
28           device.  
29
- 30     33. A device as claimed in any one of the Claims 28 to  
31           32 wherein the means for cutting the securing  
32           member is disposed adjacent to the exit.  
33
- 34     34. A device for the delivery of a shape memory  
35           securing member into a confined space, the device  
36           having an exit for the securing member and means

1 to move the securing member through the exit,  
2 wherein the securing member is stored in the  
3 device in an arcuate configuration.  
4

5 35. A device as claimed in Claim 34 wherein the  
6 securing member is stored in the device in a  
7 helical configuration.  
8

9 36. A device as claimed in any one of preceding Claims  
10 for use as a surgical instrument.  
11

12 37. A device as claimed in Claim 36 wherein the  
13 securing member is a suture or a ligature.  
14

15 38. A device as claimed in any one of the preceding  
16 Claims wherein the device includes a handle and  
17 includes a trigger means to operate the means to  
18 move the securing member.  
19

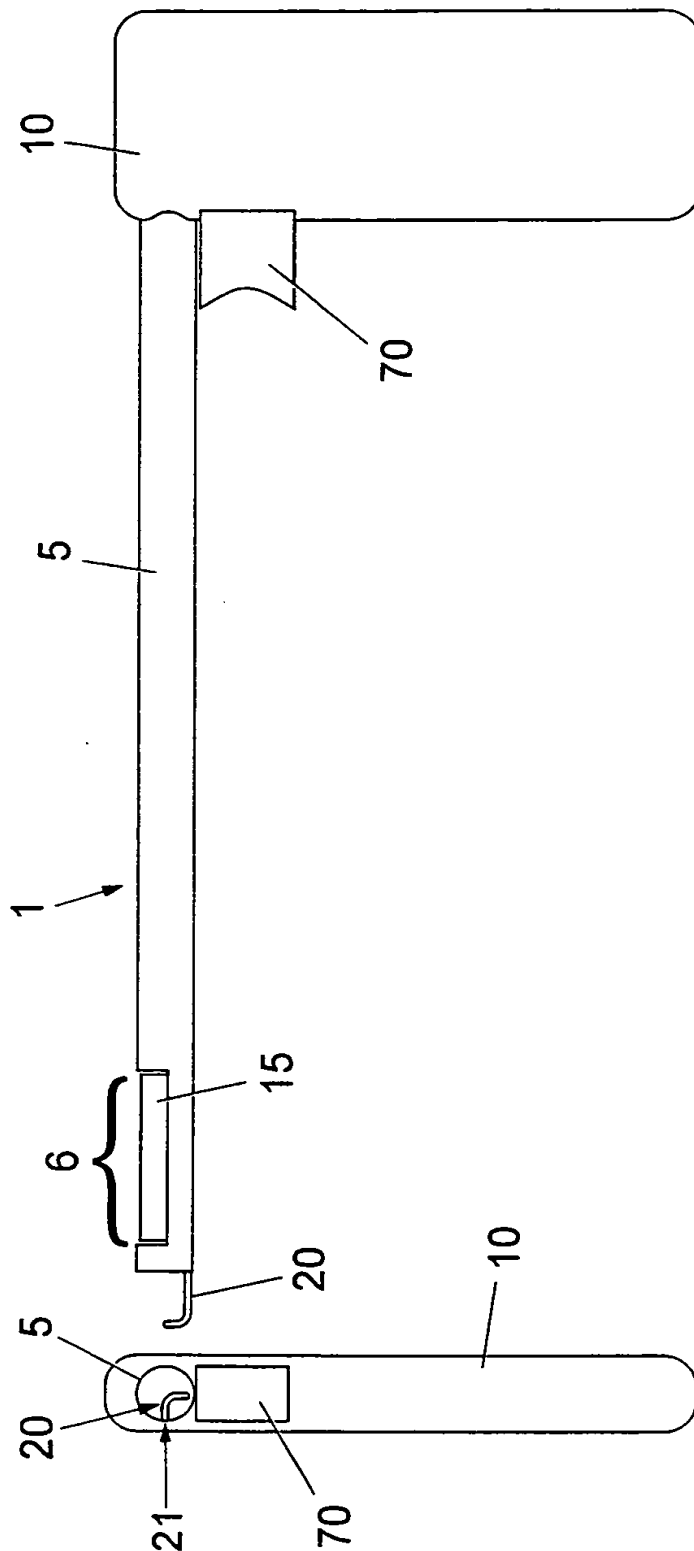
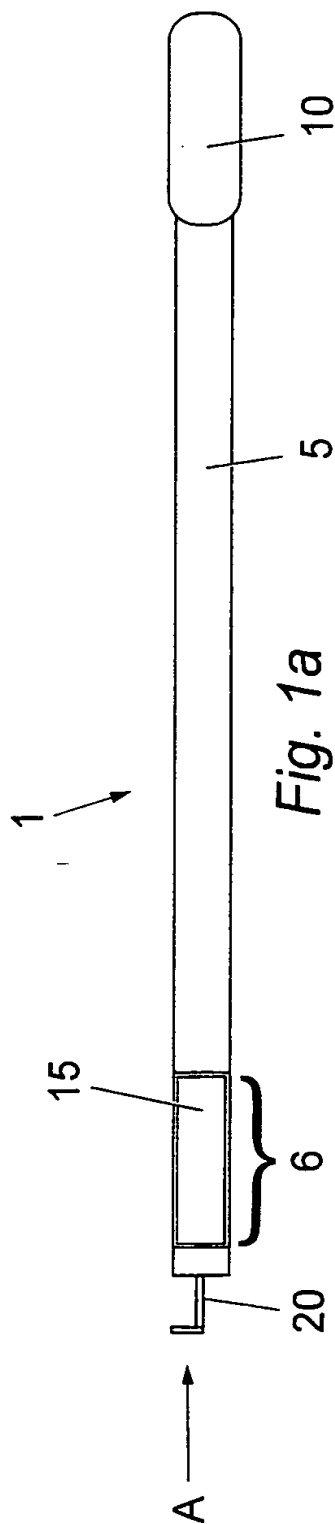
20 39. A shape memory securing member for use in a device  
21 as claimed in Claims 1 to 38.  
22

23 40. A method of delivering a securing member into a  
24 confined space using a device as defined in Claims  
25 1 to 38 wherein at least the exit of the device is  
26 located within the confined space, and the means  
27 to move the securing member is activated to  
28 deliver the securing member from the device  
29 through the exit.  
30

31 41. A method as claimed in Claim 40 wherein the  
32 securing member changes from a first configuration  
33 in the device to a second configuration upon  
34 passing through the exit.  
35

36 42. A device for the delivery of a sharp memory

1           securing member into a confined space  
2           substantially as herein defined and with reference  
3           to Figs 1a, b, c, 2a, b, c, 3 and 4a.  
4





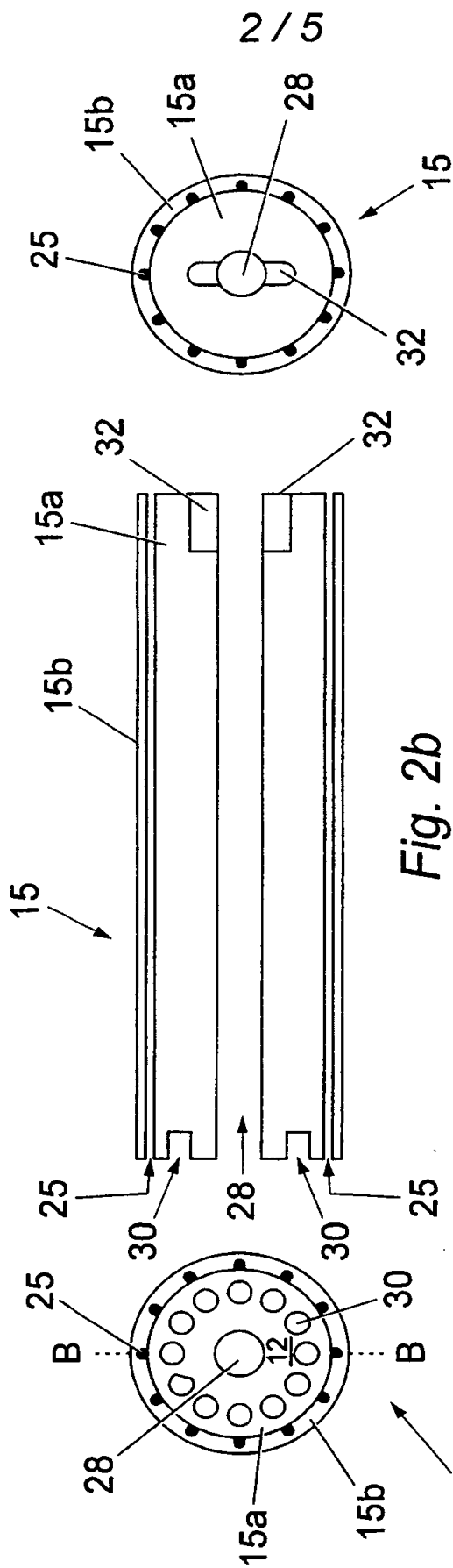


Fig. 2c

Fig. 2b

Fig. 2a

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3 / 5

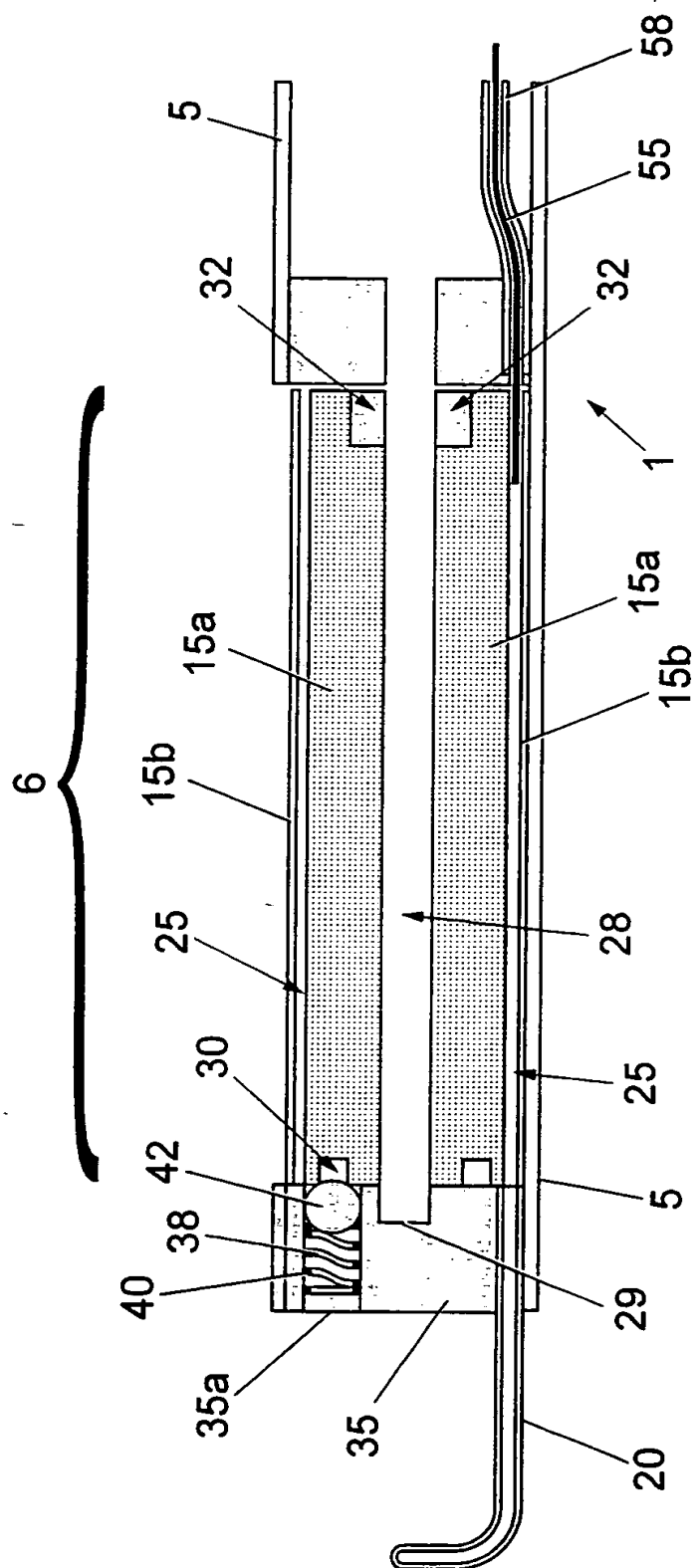


Fig. 3

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4 / 5

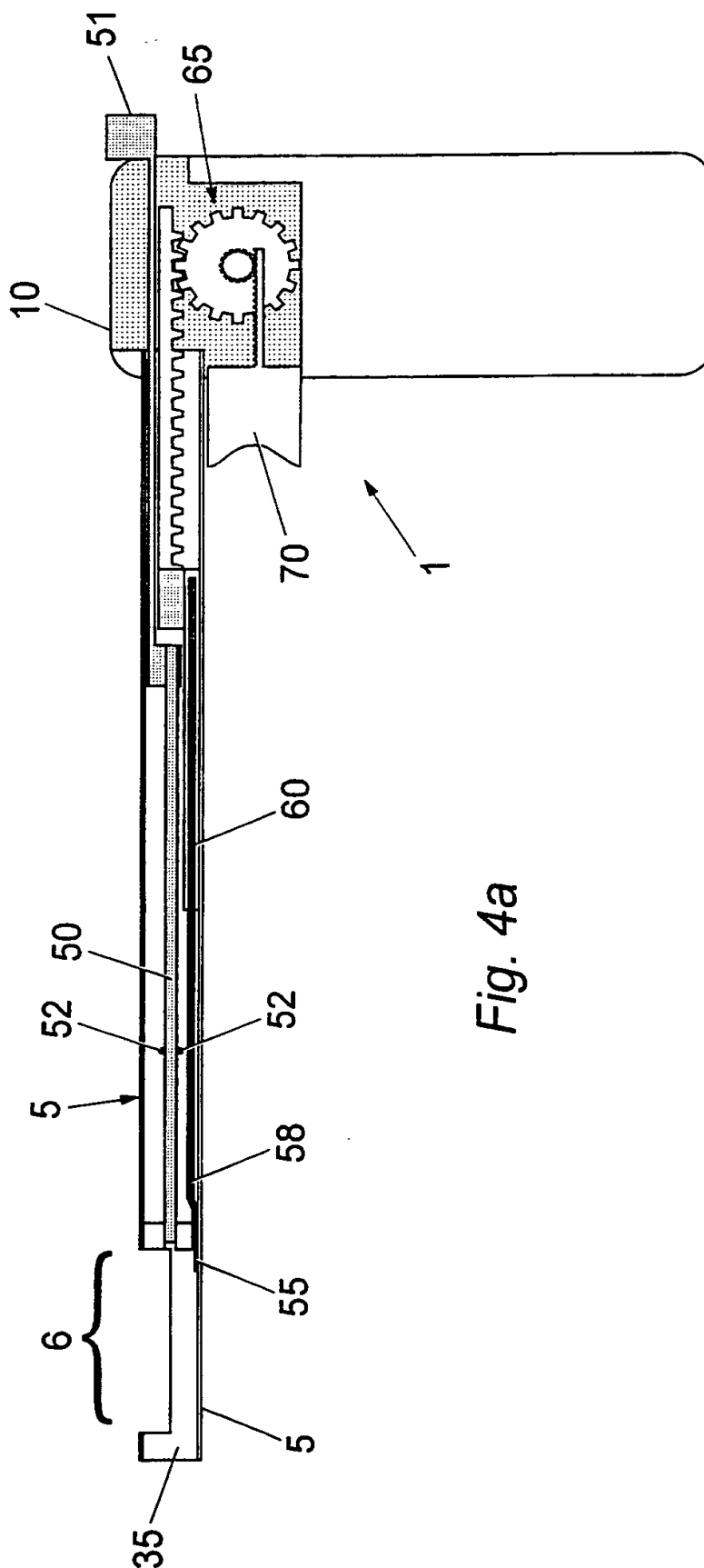
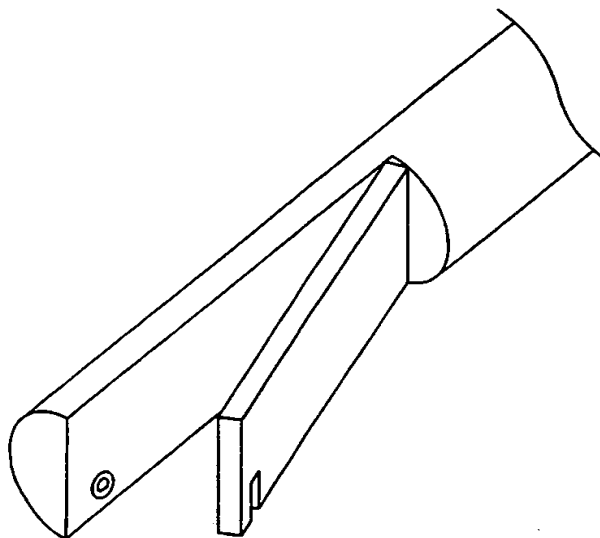


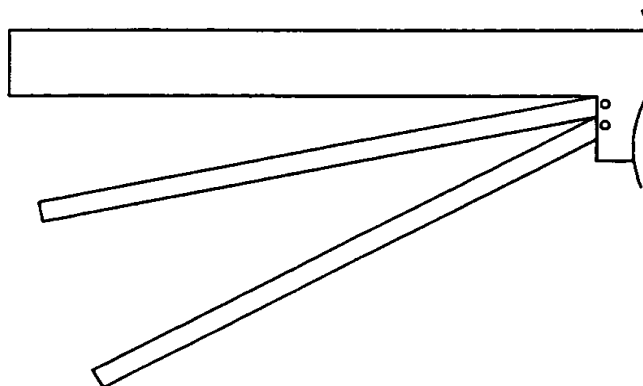
Fig. 4a

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5 / 5



*Fig. 4b*



*Fig. 4c*

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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<b>(51) International Patent Classification <sup>6</sup> :</b> <b>A61B 17/064, 17/068, 17/122</b>	<b>A3</b>	<b>(11) International Publication Number:</b> <b>WO 99/22650</b> <b>(43) International Publication Date:</b> 14 May 1999 (14.05.99)
<b>(21) International Application Number:</b> PCT/GB98/03263 <b>(22) International Filing Date:</b> 2 November 1998 (02.11.98) <b>(30) Priority Data:</b> 9722939.7 31 October 1997 (31.10.97) GB <b>(71) Applicant (for all designated States except US):</b> THE UNIVERSITY COURT OF THE UNIVERSITY OF DUNDEE [GB/GB]; Dundee DD1 4HN (GB). <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> CUSCHIERI, Alfred [GB/GB]; Denbrae Mill, Strathkiness Low Road, St. Andrews, Fife K19 9TY (GB). FRANK, Graham, Timothy [GB/GB]; 37 Naughton Road, Wormit, Newport-on-Tay, Fife DD6 8NG (GB). <b>(74) Agent:</b> MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QA (GB).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). <b>Published</b> <i>With international search report.</i> <b>(88) Date of publication of the international search report:</b> 29 July 1999 (29.07.99)
<b>(54) Title:</b> DEVICE FOR ENDOSCOPIC DELIVERY OF SURGICAL MATERIAL		
<b>(57) Abstract</b> <p>A device for the delivery of a shape memory securing member into a confined space, the device having an exit for the securing member and means to move the securing member through the exit, the device further including a magazine having a plurality of channels each of which can store a securing member is described. Preferably, each securing member is restrained in the device in a first configuration, and upon passing through the exit adopts a second configuration. One form of the magazine is a barrel. The barrel may be rotatable around an axis, and the channels can be disposed parallel to said axis or may lie in a helical configuration. This arrangement can be likened to a "revolver barrel" on a firearm. One advantage of the present invention in surgery is that it can store several sutures or ligatures to allow multiple placements without the need to withdraw the instrument from the patient.</p>		

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# INTERNATIONAL SEARCH REPORT

Intern. Appl. No.  
PCT/98/03263

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 6 A61B17/064 A61B17/068 A61B17/122

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 6 A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 92 05828 A (RAYCHEM CORP) 16 April 1992 cited in the application	1-27, 36-38
X	see page 25, paragraph 3; figures 215A,,217A	39
Y	US 4 400 170 A (MCNAUGHTON ALLEN D ET AL) 23 August 1983 see column 1, paragraph 1 see column 2, line 34 - line 40	1-27, 36-38
A	US 5 188 636 A (FEDOTOV VLADIMIR) 23 February 1993 see column 8, line 20 - line 31; figures 9,11,12	19,20
A	US 5 037 433 A (SEKONS DAVID ET AL) 6 August 1991 see figures 6C,,6D	25
	-/--	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

25 February 1999

Date of mailing of the international search report

21. 05. 99

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GERARD, B

# INTERNATIONAL SEARCH REPORT

International Application No.

PCT/GB 98/03263

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 316 469 A (KAPITANOV NIKOLAI N) 23 February 1982 -----	1



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB 98/03263

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☒ Claims Nos.: 40 and 41  
because they relate to subject matter not required to be searched by this Authority, namely:  
Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery
2. ☒ Claims Nos.: 42  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
The formulation of the claim referring to figures renders the subject-matter to be searched undefined (see also Rule 6.2(a) PCT)
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:  
1-27, 36-38, 39

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: 1 - 27, 36 - 38; 39

Device allowing for delivery of multiple separate shape memory securing member and such a securing member (claim 39)

2. Claims: 28 - 33

Device for delivering items from a continuous wire like supply

3. Claims: 34 - 35

Device for delivering devices stores in an arcuate or helical configuration

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT 98/03263

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